



# A Roadmap to Prepare for 280,000 Electric Vehicles in Phoenix by 2030



- > *Equity*
- > *Education*
- > *Leadership*
- > *Infrastructure*
- > *Access*

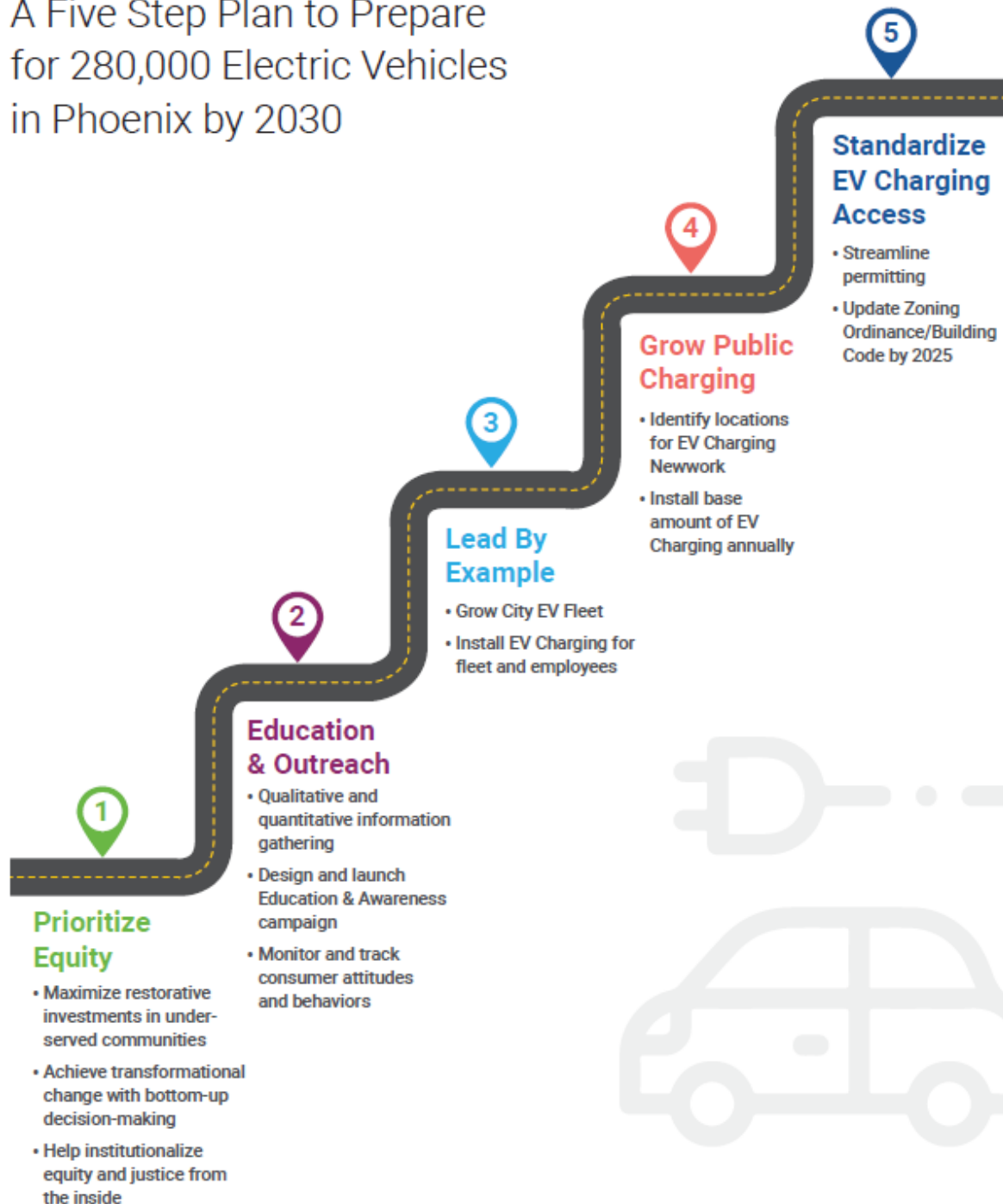
Draft Recommendations for City Council,  
Public and Stakeholder Input

Submitted by:

**City of Phoenix**  
**Ad Hoc Committee on Electric Vehicles**  
**April 12, 2022**

# Roadmap 2030

A Five Step Plan to Prepare  
for 280,000 Electric Vehicles  
in Phoenix by 2030



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## Acknowledgements

The City of Phoenix Ad Hoc Committee on Electric Vehicles was established by Mayor Gallego on June 25, 2021 and consists of one member of City Council and 14 members of the public.

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- Tim Sprague, Owner/Partner, Habitat Metro
- Vianey Olivarria, State Co-Director, CHISPA Arizona

To accomplish its work, the Ad Hoc Committee established three subcommittees (SC):

<b>SC1 - Education, Outreach &amp; Equity</b>	<b>SC2 - Public, Workplace and Home Charging Infrastructure</b>	<b>SC3 - City Fleet and City Charging Infrastructure</b>
<b>Sub-Committee Members:</b> <ul style="list-style-type: none"><li>● Councilwoman Ansari</li><li>● Omar Gonzales</li><li>● Clark Miller</li><li>● Vianey Olivarria</li><li>● Lisa Perez</li></ul>	<b>Sub-Committee Members:</b> <ul style="list-style-type: none"><li>● Omar Gonzales</li><li>● Autumn Johnson</li><li>● Catherine O'Brien</li><li>● Court Rich</li><li>● Tim Sprague</li><li>● Jason Smith</li><li>● Caryn Potter</li></ul>	<b>Sub-Committee Members:</b> <ul style="list-style-type: none"><li>● Councilwoman Ansari</li><li>● Kathy Knoop</li><li>● Caryn Potter</li><li>● Katherine Stinken</li><li>● Delbert Hawk</li></ul>

The Committee was hosted by Deputy City Manager Karen Peters and the City's Office of Sustainability staff Mark Hartman, Karen Apple, Michelle Litwin and Darice Ellis. City Departments including Public Works, Planning and Development, Public Transit, Information Technology Services, Aviation, Phoenix Convention Center, Parks and Recreation, Law, Community and Economic Development, Street Transportation, the City Manager's Office, the City Attorney and the Office of the Mayor supported the work of the committee and provided input into the draft roadmap.



## **Executive Summary**

Mayor Kate Gallego announced the launch of the *Ad Hoc Committee on Electric Vehicles* in June 2021 with a mandate to identify recommendations that would help accelerate the transition to electric vehicles (EVs) as described in the City's recently adopted Climate Action Plan. Led by its chair, Councilwoman Yassamin Ansari, the Ad Hoc Committee is preparing recommendations in the form of an "Electric Vehicle Roadmap to 2030" and this document serves as its initial draft--for which the committee is seeking Council and community input prior to making its final recommendations in June 2022.

As background, the current market desire for the electrification of transportation is both a national and global phenomenon. Businesses, governments, and the public are all signaling a strong future demand for EVs, and almost all EV Manufacturers have declared plans for a transition to fully electric offerings within the coming decade. However, this market shift, fueled by a desire for better air quality, a reduction in carbon emissions, and a reduction in vehicle operating and maintenance costs, has significant implications for cities: how do cities prepare for forthcoming public demand for EVs and the associated EV charging infrastructure, both at home, on the road, and, more importantly, how do they prioritize investments in historically underserved communities to provide equitable low-carbon transportation options?

Cities and other market players can provide support for a just transition to EVs through implementing policies, programs and initiatives that remove barriers to EV adoption and satisfy public and business need for services in a low-carbon future. Based on state and national forecasts, that future may include up to 280,000 EVs on the road in Phoenix by the year 2030.

To facilitate the transition to EVs, the City's Ad Hoc Committee on Electric Vehicles has put forward six recommendations in the draft roadmap for City Council and public input:

### **1. Adopt guiding principles for City action**

Guiding principles signal Council support for developing EV policies and programs and for investments that will accelerate the transition. The following principles are recommended by the Ad Hoc committee:

- a. Prioritize early action.
- b. Prioritize investments in underserved communities.
- c. Actively pursue federal grants and other funding opportunities.
- d. Seek partnerships with businesses, utilities, and other stakeholders.
- e. Invest in the electrification of the City's fleet and corresponding charging infrastructure, as well as installing workplace charging infrastructure for city employees.

### **2. Support accelerated EV adoption in the community**

Although vehicle manufacturers, dealers, utilities, and other EV advocates will be promoting and encouraging EV adoption in general, there are barriers to EV adoption in the region including lack of access to charging infrastructure and myths and misconceptions about EVs and their use. The Ad Hoc committee recommends the following to address these and other barriers to adoption:

- a. Assign dedicated staff to focus on public education, outreach & business training.
- b. Launch qualitative and quantitative data gathering to inform future actions.

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**Draft Roadmap to 2030**



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- c. Launch a robust EV education and awareness campaign that clarifies the benefits of EVs, dispels myths, provides resources (such as vehicle buying guides and information on charging infrastructure), and identifies the best applications for EVs.

**3. Expand access to public EV charging**

- a. Work with cities, regional planning agencies and the state on a *regional EV Infrastructure needs assessment and siting recommendations* for public EV charging stations.
- b. Leverage local, state and federal funding to install 500 City-hosted public charging stations by 2030 including installing a minimum number of EV charging stations each year in parks, city parking facilities and in rights-of-way.

**4. Support access to home, business and workplace EV charging**

- a. Investigate opportunities to streamline the permitting process for installing workplace, business, home, and multi-family EV charging stations.
- b. Develop proposals for EV Ready building codes and zoning ordinances for stakeholder input and future adoption.
- c. Work with utilities on developing an education program specific to builders, developers, and businesses.

**5. Develop and pilot a local model of e-mobility investment in an underserved community**

- a. Assign dedicated staff to focus on equity and build relationships with community leaders and advocates.
- b. Develop an understanding of the unique mobility needs of underserved communities and design solutions to meet those needs.
- c. Launch a local model of e-mobility investment in an underserved (“front-line”) community as recommended by community leaders and advocates.

**6. Lead by Example**

- a. Evaluate infrastructure/power needs and financial resources to support the transition of light-duty vehicles to EV.
- b. Adopt a “preferred purchasing policy for EVs” provided it meets the business needs and is in a similar price range to a non-electric vehicle model from a life-cycle cost perspective (.i.e., accounting for savings in fuel costs and maintenance).
- c. Pilot electrification in medium and heavy-duty equipment such as transit buses, refuse trucks, and street sweepers to better understand electric equipment operating characteristics.
- d. Proactively install supporting charging infrastructure to prepare for future adoption of EVs in the City fleet.
- e. Identify City employee charging needs and provide access to charging infrastructure to City employees to meet demand.
- f. Implement training of employees for EV driving, EV charging and EV maintenance prioritizing employee change management to achieve effective employee engagement.

The following report contains additional details on the specifics and timeline of these six recommendations. The Ad Hoc committee will be seeking Council and community input on these recommendations in April and May 2022 and will present a completed Electric Vehicle Roadmap to 2030 with updated recommendations for City Council consideration in June 2022.

## Proposed Electric Vehicle Roadmap to 2030



### Introduction

#### Electric Vehicles (“EVs”)

The term EV encompasses several different types of vehicles. Specifically, all EVs can be plugged-in and powered solely by electricity; however, some are also powered by an internal combustion engine (ICE) using gasoline or conventional fuels. Many models of light duty vehicles such as passenger cars are available on the market today, but new applications for medium- and heavy-duty (e.g., buses, delivery vans, refuse collection, street sweepers, and long-haul trucks) are being manufactured and starting to appear in the marketplace.





The up-front purchase price of an EV is typically more than a comparative ICE vehicle due to the high cost of the large battery, but the incremental cost can often be offset from a “life-cycle” perspective (i.e., by including the savings from reduced maintenance and the avoidance of the use of gasoline). However, as technology advances and battery manufacturing capacity increases, the upfront EV cost is likely to decrease. According to a March 25, 2021 Bloomberg New Energy Finance Hyperdrive Daily article, EVs should be cheaper to buy on average than ICE vehicles in about five years; that’s the point at which EVs will reach price parity with ICE vehicles. Price parity refers to the point at which an automaker can build and sell an EV with the same margin as an ICE vehicle, assuming no subsidies are available.

Table 1: EV Types

Vehicle Type	Description	Example
Plug-In Hybrid Electric Vehicle (PHEV)	PHEVs are powered by an ICE (internal combustion engine) and an electric motor that uses energy stored in a battery. The vehicle can be plugged into an electric power source to charge the battery. PHEVs can travel on either electricity or gasoline. The all-electric range of a PHEV can be from 10 to over 50 miles, depending on the model.	Chevrolet Volt 
Battery Electric Vehicle (BEV)	BEVs use a battery to store the electric energy that fully powers the motor. A BEV does not have an ICE. BEV batteries are charged by plugging the vehicle into an electric power source. The range of a BEV on a full charge can be over 500 miles, depending on the model.	Nissan Leaf 

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Table 2: Other Electrified Vehicles

Micro-Mobility Examples	Description	Example
Electric Bicycle (E-Bike)	Bicycle with an electric motor used to assist propulsion. Electric bicycles use rechargeable batteries and can travel up to 15 to 20 mph. Many bikes can assist the rider's pedal-power and/or can add a throttle.	
Electric Scooter (E-Scooter)	Device weighing less than one hundred pounds, with handlebars and an electric motor that has a maximum speed of 20 mph.	
Medium and Heavy-Duty Examples	Description	Example
Electric Street Sweeper	Powered by an electric motor with the advantages of no tailpipe emissions. Street Sweepers are used to control dust and improve air quality, so the electric option aligns well with this purpose.	
Electric Transit Bus	Transit buses powered by an electric motor enable transit agencies to significantly reduce operating costs while delivering clean, quiet transportation to the community.	

## Benefits of EVs

The City of Phoenix supports the use of different transportation options for City employees, residents, and visitors - including biking, walking, public transportation, carpooling, and vehicle sharing. However, given the large geographical area of the city, in many circumstances, a private vehicle can be the most convenient option for navigating around the community. EVs are recommended over gasoline- and diesel-powered vehicles with internal-combustion engines (ICE) as they better support the City's air quality, climate, transportation, and sustainability goals as outlined in the City's climate action plan.

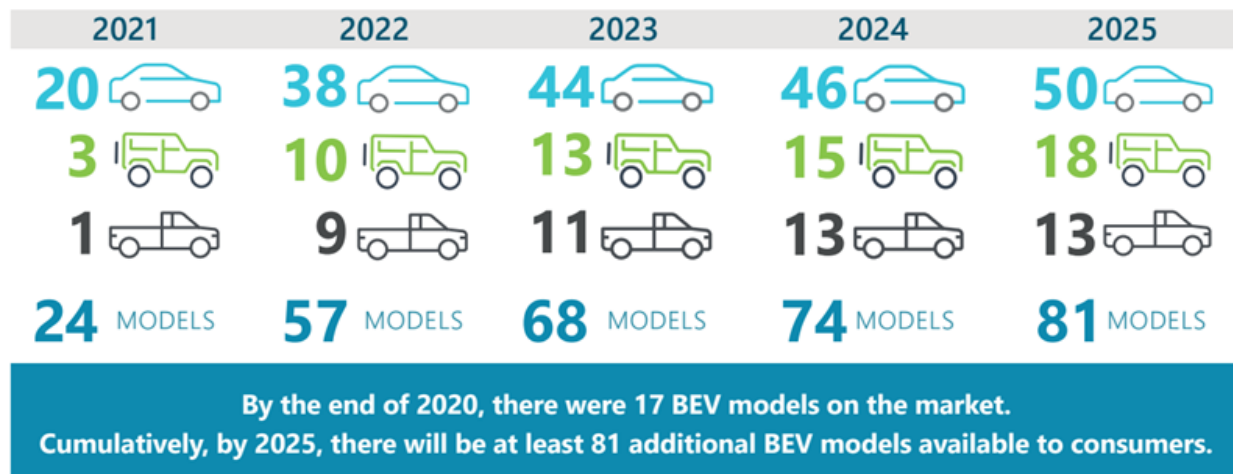
The benefits of EVs include:

- EVs have little or no tailpipe emissions (depending on the type of vehicle), so they reduce local air pollution, global GHG emissions, and improve public health.
- Regardless of the electricity generation mix, EVs have much lower greenhouse gas (GHG) emissions than ICE vehicles, and they have the ability to continually lower emissions as the electricity generation mix gets cleaner.
- The cost to charge an EV can be less than 10 percent of the price of the equivalent amount of gasoline and can even be lower if using utility time-of-use rates. The U.S. Department of Energy's (DOE) eGallon tool provides a general cost comparison based on U.S. averages.
- EVs, particularly BEVs, which do not have an ICE, require very little maintenance. Because of the lower maintenance and fuel costs, EVs have a lower lifetime cost of ownership than conventional ICE vehicles.

## Supply of Electric Vehicles

While EVs currently represent less than two percent of all light-duty vehicles in the U.S., vehicle manufacturers are investing in EV technology and some manufacturers suggest an all-EV future. In 2022, there were approximately 225 light duty EV makes and models available on the market and 57 were exclusively battery electric vehicles (BEVs), as shown in Figure 3.

Figure 3: Battery Electric Vehicle models being added to the light-duty market.



## National EV Funding Efforts

There are several notable EV initiatives underway at the national level. The US Department of Transportation (DOT) Federal Highway Administration (FHWA) is establishing a national network of alternative fueling and charging infrastructure along national highway system corridors. There are several designated corridors within Phoenix, including I-10 and I-17. While this designation does not guarantee funding for projects, it may give I-10 and I-17 priority for future funding. Table 2 provides an overview of federal incentives available as of June 2022, including a description and funding amounts.

*Table 2: Federal EV Funding Initiatives*

Funding Source	Funding Amount	Description
Qualified EV Tax Credit	Up to \$7,500 per vehicle	A tax credit is available for the purchase of a new qualified EV, with the amount based on each vehicle's battery capacity and the gross vehicle weight rating. The credit will begin to be phased out for each manufacturer after 200,000 qualified EVs have been sold by that manufacturer for use in the US. To date, all Tesla and GM models have met the 200,000 EVs sold and do not qualify for the tax credit.
Federal Transit Administration Low or No Emission Vehicle Program	Varies up to a total of \$84.45 million available annually	State and local governments are eligible to receive program funds to purchase or lease zero-emission and low-emission transit buses and supporting fueling facilities.
Infrastructure Investment and Jobs Act (IIJA)	Formula EV charging program funds up to \$5 billion over five years and various EV charging and refueling competitive grants available, up to \$2.5 billion over five years. There is also other funding across other sectors.	Formula program provides funding to States to deploy publicly accessible EV charging infrastructure. Competitive grant programs provide funding to local governments to strategically deploy publicly accessible EV charging infrastructure along designated alternative fuel corridors or publicly accessible areas.  Other funding includes Clean School Bus Program, Grants for Buses and Bus Facilities, Surface Transportation Block Grant Program, Congestion Mitigation and Air Quality Improvement Program and the Carbon Reduction Program.






## Electric Vehicle Charging

Charging equipment for EVs, also called electric vehicle supply equipment (EVSE), is available in different levels based on how quickly it can charge the vehicle's battery. The time needed to fully charge an EV will vary based on the size of the battery, how depleted the battery is, and the electric current of the EV charging equipment.

### Light-Duty Vehicle Charging

EV drivers have the flexibility to charge at a variety of locations, including home (single-family and multi-family), work, and other destinations such as shopping centers, restaurants, and fleet parking facilities. Figure 1 highlights the three levels of charging and operational characteristics. Level 1 EV chargers are mostly used in single-family homes, Level 2 EV chargers are also used in single-family as well as commercial and multi-family buildings, and Level 3 DC Fast Chargers are primarily used for vehicle fleets located at commercial properties and along interstate corridors.

*Figure 1: Representative Operational Characteristics of EV Chargers for Light-Duty Vehicles*

KNOW YOUR EV CHARGING STATIONS		
 <p><b>AC Level One</b></p>	 <p><b>AC Level Two</b></p>	 <p><b>DC Fast Charge</b></p>
<b>VOLTAGE</b> 120v 1-Phase AC	<b>VOLTAGE</b> 208V or 240V 1-Phase AC	<b>VOLTAGE</b> 208V or 480V 3-Phase AC
<b>AMPS</b> 12–16 Amps	<b>AMPS</b> 12–80 Amps (Typ. 32 Amps)	<b>AMPS</b> <125 Amps (Typ. 60 Amps)
<b>CHARGING LOADS</b> 1.4 to 1.9 kW	<b>CHARGING LOADS</b> 2.5 to 19.2 kW (Typ. 7 kW)	<b>CHARGING LOADS</b> Typically 50kw-350kw
<b>CHARGE TIME FOR VEHICLE</b> 3–5 Miles of Range Per Hour	<b>CHARGE TIME FOR VEHICLE</b> 10–20 Miles of Range Per Hour	<b>CHARGE TIME FOR VEHICLE</b> 80% Charge in 20–30 Minutes

Most EV charging occurs at home. However, there are some challenges with installing EV charging infrastructure in multi-family developments, including access to reliable parking, billing, sufficient power supply, and ownership concerns. Workplace charging is a significant opportunity for City of Phoenix and Phoenix's employers, as workplace charging helps increase the convenience of driving electric for employees and encourages charging during off-peak hours. Similarly, access to public charging is a key factor in decreasing range anxiety and increasing the convenience of driving EVs in the region.

## Approach of the Ad Hoc Committee

When developing the recommended policies and programs for consideration, the following core principles were identified:

**Equity**—Ensure equity principles are incorporated into policies and programs to make EVs affordable and accessible to underserved, disadvantaged communities, to better understand their mobility needs, and to identify solutions to meet those needs.

**Financial Resources**—Identify potential funding opportunities provided by the federal government through grants, direct or formula/competitive allocations, local utilities incentive programs, city budget allocations, and vendor offerings to assist in covering the cost of EV fleet transitions and EV charging infrastructure.

**Partnerships and Relationships**—Leverage and engage community, business, and utility stakeholder partnerships and establish new relationships with local community agencies, community groups, nonprofits, businesses, and residents to identify needs and resources to create innovative solutions.

**Policy Options**—Include and request early and continued feedback and involvement from City departments in development of EV policies and programs to ensure they are aligned with resources and goals.

## Roadmap Assumptions

In recognition of technology availability, current and forecast trends, this EV Roadmap focuses on actions in the near term for light-duty passenger vehicles and trucks (SUVs, crossovers, and pickup trucks), for personal use and fleet use cases. Heavy-duty equipment has different considerations from light-duty vehicles when it comes to electrification. As technology advances in the medium- and heavy-duty sector, the City will pilot test opportunities and collaborate with manufacturers on solutions. For example, although viable solutions are still under development, hydrogen fuel-cell propulsion systems have the potential to service the heavy-duty sector.

A second assumption is that although EV Models have been announced, mass-market availability may not happen until after 2024. However, based on manufacturer declarations, the number of EV Models available for purchase will overtake the number of internal combustion engines (ICE) prior to 2030.

## Current State of Electric Vehicles in Phoenix

The City's 2021 Climate Action Plan includes goals for EV adoption, EV charging equipment deployment, and the incorporation of equity principles. The current state of EVs in Phoenix includes the following challenges and opportunities:

- Current citywide goals for EV adoption are in line with the federal government's 2030 goals for nation-wide EV adoption—projecting up to 50% of car sales to be EV by 2030.
- The City currently does not have the number of EV chargers, nor the supporting infrastructure, to support Phoenix's target numbers of EVs for the public, the city's fleet, or workplace users.
- Federal funding and grants are being made available and will assist in the planning and deployment of EV charging infrastructure.
- Other cities are implementing EV policies, programs, and practices that can be leveraged to increase EV adoption, support, and awareness.

### **Current Light-Duty EV Adoption Rates**

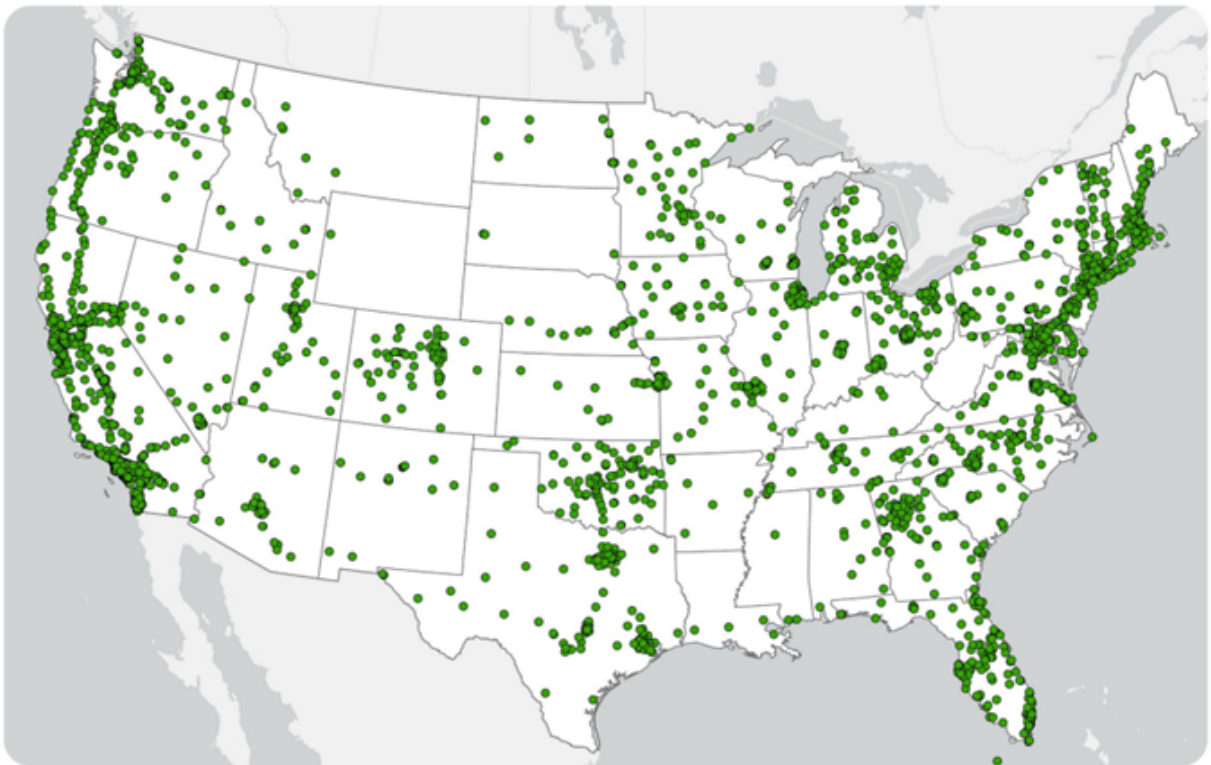
Phoenix residents and businesses are adopting EVs; however, adoption rates must accelerate to achieve the 2030 EV goals identified in the City's 2021 Climate Action Plan.

The Maricopa Association of Governments (MAG) forecasts plug-in electric vehicles (PEV) will increase significantly at a compound growth rate of 36.4% from 2021 to 2029<sup>1</sup>. Similarly, the Arizona Statewide Transportation Electrification Plan set a goal of 1.1 million EVs in the State by 2030 which, when downscaled to the City of Phoenix, translates to approximately 250,000 vehicles by 2030<sup>2</sup>.

One of the primary obstacles to more widespread adoption of EVs is range anxiety due to the limited network of EV charging stations, including along highway corridors throughout the National Highway System. According to national survey data, 78 percent of Americans believe that finding an EV charging station is at least moderately difficult. Of drivers who are not planning to buy or lease an EV when they purchase their next vehicle, 48 percent reported concerns about not enough public charging stations.

As of April 2021, there were approximately 38,000 publicly accessible EV charging stations nationally with approximately 79,000 charging outlets (i.e., a charging station typically has two outlets—to charge two vehicles at the same time). Figure 6 identifies the location of DC Fast charging stations in the US.

**Figure 6: DC Fast Charging Stations in the Continental U.S**



To expand this national network, the current Bipartisan Infrastructure Law is providing \$7.5 billion in new funding to expand the charging network nationwide over the next five years with the goal to have a DC fast-charge station (DCFC) every 50 miles along U.S. highways.

<sup>1</sup> Maricopa Association of Governments Battery Electric Vehicle (EV) Modeling Support Task - 2021

<sup>2</sup> <https://illumeadvising.com/files/Arizona-Phase-1-TE-Report-Final.pdf>

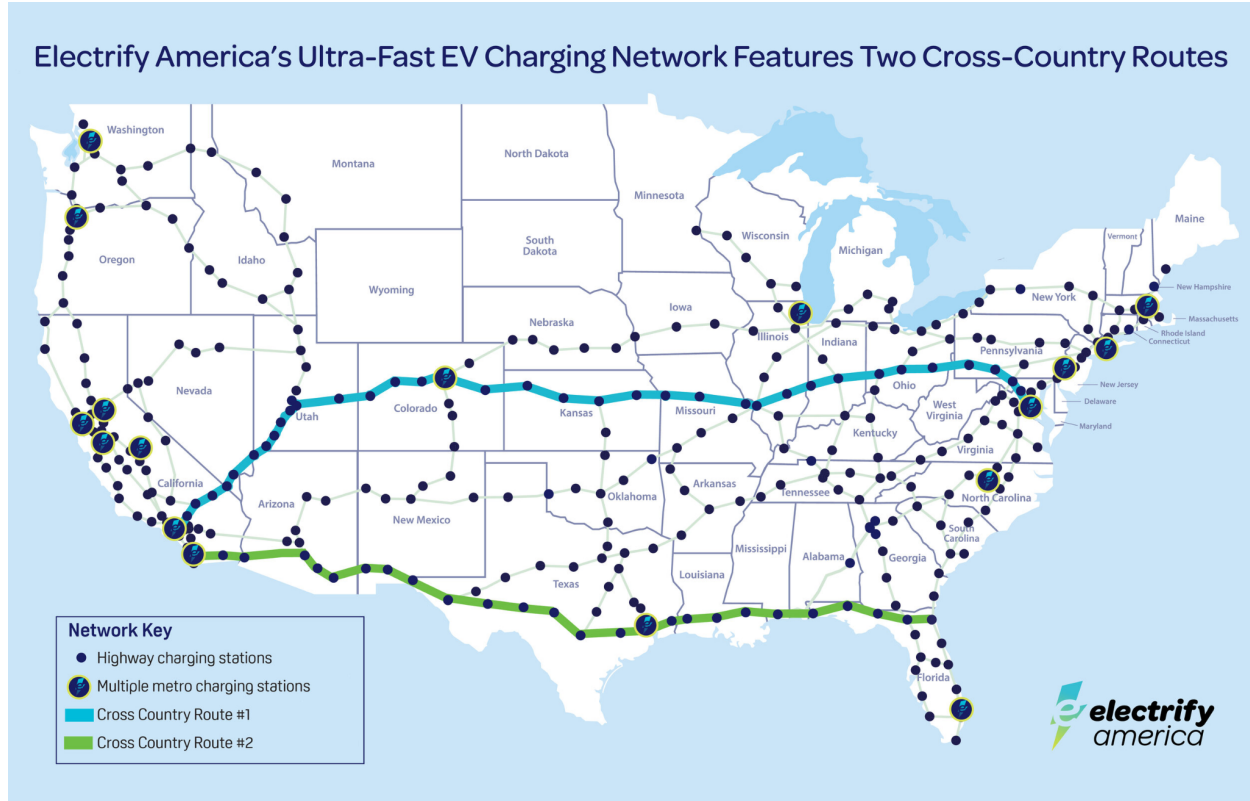
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More specifically, Electrify America has added 600 DCFC sites (with over 2600 charging ports) over the last three years and has targeted two cross-country routes and a number of interstate highways for national connectivity including the I-10 and the I-17.

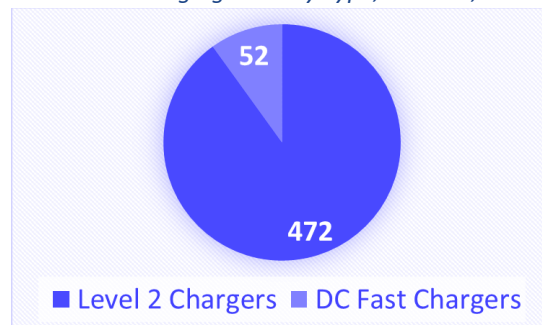
Figure 7: DC Fast Charging Stations installed by Electrify America



### Public EV Charging Ports in Phoenix

- According to the *Alternative Fuels Data Center* (AFDC), 472 Level 2 public charging ports and 52 direct current fast charging ports (DCFC) are located in Phoenix as of February 2022, as shown in Figure 8. The Level 2 EV chargers comprise 90% of the available public EV charging ports, while DCFCs comprise 10% of the available public accessible ports.

Figure 8: EV Public Charging Ports by Type, Phoenix, February 2022



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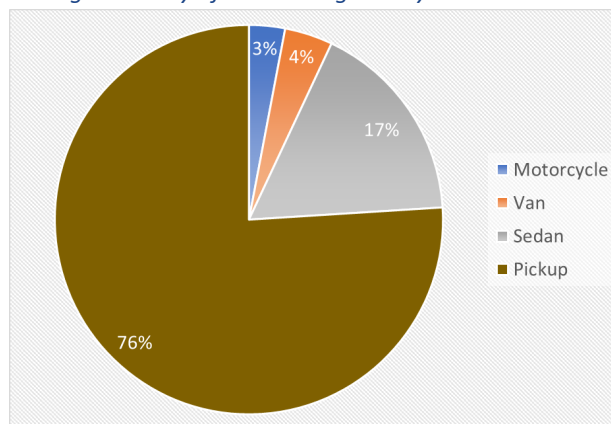
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- The *EV Infrastructure Projection Tool* (EVI-Pro) from the US Department of Energy calculates that 280,000 electric vehicles would require 3,000 Level 2 charging ports and 430 DC Fast Chargers (DCFC) in the city by 2030--approximately six times the current number of public Level 2 charging ports.
- The ratio of Level 2 EV charging ports versus Level 3 DC Fast Charge (DCFC) has been initially forecast at a 6-to-1 ratio but this ratio may change over time based on market needs.
- Based on the above ratios, it is estimated that 500 publicly accessible EV charging ports are needed on City properties by 2025 (although this number will be modified over time based on EV market activity). This could be roughly allocated by installing 200 charging ports in City garages and approximately 300 for on-street charging.

### City of Phoenix Fleet EVs, and Fleet and Employee EV Charging Ports

The City of Phoenix operates and maintains approximately 7,700 light, medium, and heavy-duty vehicles in its fleet. Of the approximate 7,700 total fleet vehicles, 3,837 are classified as light duty vehicles. As shown in Figure 9, the majority of the light duty fleet is pick-up trucks.

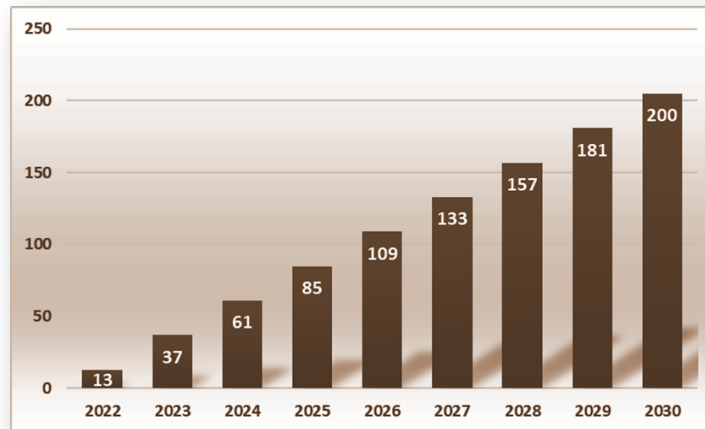
Figure 9: City of Phoenix Light Duty Fleet Vehicles



As of February 2022, the City of Phoenix currently has 13 EVs in the light duty fleet—nine sedans and four motorcycles. In the next eight years, the City has a goal to transition 200 light duty gas powered vehicles to EVs. In order to reach this goal, on average, the City needs to transition approximately 24 EVs a year. Figure 10 identifies the current number of EVs and a sample path to the 2030 EV fleet goals.

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Figure 10: City of Phoenix sample path to the 2030 EV Fleet Goal



### Strengths and Opportunities

The 2021 Climate Action Plan set ambitious targets for EVs for 2030:

- Accelerating EV action to support 280,000 electric vehicles citywide by 2030
- Support for 3,500 public and workplace charging stations citywide
- a target of 200 EVs in the City Fleet

In support of these goals, several other market players are helping the transition to the electrification of transportation:

- Electric utilities have ambitious EV goals, incentives, and dedicated staff to accelerate the transition to EVs with a target of over 1.1 million EVs in the state by 2030.
- The federal government is providing \$7.5B in funding for EV Charging infrastructure in the recently signed Bipartisan Infrastructure Law.
- Electrify America ([electrifyamerica.com](https://electrifyamerica.com)) is investing \$1 billion in additional EV Infrastructure on national highways using funds from the *Volkswagen Environmental Mitigation Trust Settlement* ("VW Settlement").
- Vehicle manufacturers are shifting priorities toward continued research and development, and expansion of EV models and capabilities in the market.
- And, lastly, polling by the American Lung Association indicates that Arizona residents are supportive of the electrification of transportation<sup>3</sup>.

### Barriers to EV adoption<sup>4</sup>

- actual and perceived costs of EV purchasing/ownership
- limited number of EVs currently available
- lack of EV-ready building codes and limited access to EV charging in multi-family buildings
- current limitations of EVs (range and performance) for meeting business and personal needs
- range anxiety partially due to current lack of charging infrastructure
- cost of adding EV charging infrastructure to existing multi-family buildings
- lack of public knowledge and experience with EVs & EV Charging equipment

<sup>3</sup> <https://www.lung.org/media/press-releases/lung-association-az-supports-renewable-energy>

<sup>4</sup> As identified in [The Arizona Statewide Transportation Electrification Plan](#)



## GOALS AND STRATEGIES

### 1. PRIORITIZING EQUITY

As the Ad Hoc committee developed recommendations to accelerate the adoption of electric vehicles across the city, they emphasized the importance of also ensuring those recommendations addressed the unique mobility needs of historically underserved communities. EV Equity does not translate to simply providing electric vehicle charging in these communities, but instead, identifies residents in underserved communities, conducts listening sessions to understand their unique mobility needs, and implements solutions to meet those needs.

In recent years, City outreach to underserved communities has seen significant benefit from partnering with community-based organizations (CBOs) to connect outreach directly with those community voices that can articulate the needs of the local residents and businesses. As programs and infrastructure are rolled out in these underserved communities, the City should be deliberate in its outreach, and be hearing back from community members that the process was inclusive, and that their input was incorporated into solutions.

The Ad Hoc Committee outlined a collaborative approach to center justice and embed equity through investment in underserved communities. The equity priorities are based on the federal *Justice 40*<sup>5</sup> goals and principles:

1. Maximize restorative investments in underserved communities.
2. Achieve transformational change with bottom-up decision-making (community input).
3. Help institutionalize equity and justice from the inside (policies that prioritize equity).

Summary of Equity Recommendations (in line with Best Practice)		Year
1.	Assign dedicated staff to focus on equity and build relationships with community leaders and advocates	2022
2.	Develop an understanding of the unique mobility needs of underserved communities and design solutions to meet those needs.	2023
3.	Launch local model of e-mobility investment in an underserved (“front-line”) community as recommended by community leaders and advocates.	2024-2025

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<sup>5</sup> *Justice40* is an interagency initiative led by the White House Environmental Justice Interagency Council (IAC), which is convened by the Council on Environmental Quality (CEQ). Based on its original vision, its purpose is to ensure that 40% of the benefits of federal investments flow to disadvantaged communities.

Detail Recommendations

By December 2022

**Hire or assign a dedicated staff member focused on equity as part of a citywide EV team to implement the following actions.**

- Identify underserved (“front-line”) communities, existing disparities in Phoenix, and equity metrics
- Adopt guiding principle to invest at least 40% of mobility/electrification funding in underserved communities
- Identify compensation desired and funding source(s) for community participants.

By December 2023

- Identify key communities and investment priorities leveraging data, for example, create an Environmental Justice (EJ) Screening tool with the following features:
  - Model of community collaboration and accountability;
  - Integrated progress metrics;
  - Multilingual, user-friendly, and accessible;
  - Open to feedback from the community, ready to modify the tool as needed.
- **Identify measurable metrics** and manner of reporting for clear reporting and evaluating processes to ensure accountability and transparency

By December 2025

- Launch local model of micro-mobility investment in an underserved community
- Launch investment targeting priority communities (for example, 25% of projects to be located in the boundaries of, and benefit individuals living in, disadvantaged communities.

**Example:** Community workshops reach deep in community through trusted partners. Each community can articulate its particular mobility needs—EV Car Shares, eUber, eBikes, eScooters, Cool Corridors, etc., and a program is designed and launched to meet those specific needs in a prioritized community.

## 2. ACCELERATE PUBLIC ADOPTION OF ELECTRIC VEHICLES

### 2a: Education and Outreach

**Goal:** Launch a robust public education & awareness campaign to help meet the climate action plan goal of 280,000 electric vehicles registered in the City of Phoenix by 2030.

Summary of Education & Outreach Recommendations		Year
1.	Assign dedicated staff to focus on Public Education, Outreach & Training	2022
2.	Launch a qualitative and quantitative public data gathering	2022
3.	Launch Public EV Education & Awareness Campaign	2022

#### Detailed Recommendations:

##### By December 2022

- **Support/expand ideas for federal funding opportunities** (Bipartisan Infrastructure Law).
- **Assign staff** to coordinate ongoing Education & Outreach.
- **Identify robust approach** to gathering information on public views and sector-specific mobility needs (e.g., small business, underserved communities, and workers) for Year 2 implementation.
- **Identify goals and scope** of an Education & Outreach program considering equity.
- **Identify funding** needed to support a broad education & awareness campaign.
- **Propose recommendations for future of Public Input.**

##### By December 2023

- **Launch qualitative and quantitative information gathering phase** leveraging tools such as surveys, workshops, focus groups, and street teams to shape design of education and outreach strategy to identify barriers to adoption of EVs and public understanding of the benefits (Fall 2022)
  - Include community/business needs for the time-of-day charging
  - Track and include incentives for participation from disadvantaged communities (e.g., gift cards) varying time of outreach to accommodate schedules
  - Integrate educational materials into information-gathering process
- **Launch “Phase 1” education and awareness campaign** in English and Spanish that may include flyers, bill inserts, webinars, phone banks, newspaper ads, billboards, TV, and ride-&-drive events, outreach to students, listening sessions, an engaging EV101 video, etc.
  - Explore possible partnerships with local media (print/cable/tv) to assist with outreach efforts including publications/media in Spanish.

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- Increase awareness of the real estate development community and property owners on the benefits of incorporating ESVE in their properties.
- **Launch program to monitor public attitudes** related to EVs by sector (dual-language, disadvantaged communities, and workers).
- **Develop business and employee guidance and education around EVs**
  - Create a business-friendly information clearinghouse to educate developers and owners on how to easily install EV charging infrastructure.
  - Create guidance for those businesses wanting to install EV charging at their sites.
  - Launch an employee and business workplace electric vehicle charging stations (EVSE) awareness and education program.

### By December 2025

- **Continue to track changes** in public attitudes towards EV to identify barriers to adoption—including distribution of EV sales and revenue generated from sales tax.
- Review metrics and data from “Phase 1” to identify strengths and weaknesses to be considered when updating the “Phase 2” plan.
- **Launch “Phase 2” education and awareness campaign for broader engagement.**

## 2b: Public Charging Infrastructure

**Goal:** Install at least 500 public EV charging stations on City properties or rights-of-way (ROW) by 2030, prioritizing equity.

Summary of Recommendations for Public Charging Infrastructure		Year
1.	Work with cities/MAG/State on a regional EV Infrastructure needs assessment & siting recommendations for public EV Charging stations	2022 & 2023
2.	Leverage local, state and federal funding to install 500 City-hosted public charging stations by 2030	2022-2030

### Detailed Recommendations

#### By December 2022

- Conduct solicitation to engage consultant(s) or assign staff to collect data, identify potential charging locations and begin investigative work on future actions listed below.
- Incorporate e-bike considerations as part of mobility planning.
- Identify collaborative multi-city and regional EV charger bulk purchase opportunities on a local, state, and national level to lower upfront equipment cost (i.e., driveevfleets.org, other cities, MAG).
- Assign permanent staff role that will coordinate ongoing and long-term EV charging implementation, maintenance, and investments.
- Work with third-party charging service providers (CSP) to explore funding options:
  - Hosting third-party owned charging infrastructure on City property or in ROW in place of City-owned infrastructure where such makes economic sense and limits risk.
  - Sponsorship/advertising/branding options for charging stations (to offset costs as well as provide a potential revenue stream).
  - Private/public partnership business models.

#### By December 2023

- Work with cities/MAG on a regional EV Infrastructure needs assessment & siting recommendations
- Identify potential locations for the proposed 500 public charging stations with a plan to complete by 2030 that considers equity and charging time. While Level 1 charging can cost-effectively address workplace charging needs in some cases, Level 2 or Level 3 charging equipment will also be needed at specific locations. The City should explore partnerships with nearby businesses that could provide charging or needed parking spaces to better optimize pre-existing parking structures.
- Work with City departments to identify and recommend parking locations for the City fleet.

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- Create recommendations for on-street charging in City right-of-way (ROW) to assist equity and support EV charging capability for nearby multi-family buildings. Design and safety standards will need to be considered for ROW permitting and approval.
- Explore new policies with third-party collaborators to support public charging:
  - Expand current policies to include EV Charger advertising revenue (i.e., LED screens) and co-branding to fund future EV charging infrastructure and offset network fees and electricity costs.
  - Explore policy that determines charging rates for customers charging on City property or in ROW—to incentivize charging during “off-peak” daytime charging (also noting lower carbon impact). Work with utilities to identify “off-peak” times.
- Evaluate and implement pilot programs citywide for medium/heavy duty fleet to demonstrate new EV service equipment (EVSE) providers
  - Coordinate with utilities to perform a utility analysis of grid capacity and load management to identify opportunities for ROW charging that leverage existing infrastructure (such as streetlight infrastructure for EV charging)
- By June 2023, install 20 new EV Charging ports on City property/ROW

**By December 2025**

- install new EV Charging ports on City property/ROW to reach 300 charging stalls in the ROW by the end of 2025.



## 2c: Workplace, Business, and Multi-Family Charging Infrastructure

### Goal:

- Enable at least 500 workplace and business chargers by 2030
- a minimum of 20% of total EV chargers to be installed near and at small businesses and small commercial buildings.

Summary of Recommendations for Workplace & Business Charging		Year
1.	Recommend opportunities to streamline the permitting process for installing workplace, business and multi-family electric vehicle supply equipment (EVSE)	2022
2.	Develop proposals for EV Ready building codes and zoning ordinances for stakeholder input	2022-2023
3.	Support education and outreach program specific to businesses	2022-2024

### Detailed Recommendations

#### By December 2022

Explore opportunities for streamlined permitting for multi-family and commercial installation of EVSEs.

**Justification:** Making EVSE permitting quicker and more efficient will encourage faster deployment of EV charging facilities. In a world where jurisdictions are competing to attract private investment in EV infrastructure, jurisdictions that make it the quickest and easiest will be the focus of early adoption. Further, a streamlined process will reduce the burden for City staff as the number of these projects increase and take up more and more staff time. Multi-family may include ground-floor retail that requires access to EV charging infrastructure.

#### By December 2023

Develop proposals for EV Ready building code and zoning ordinance updates to support EV Ready updates with the following attributes:

- Work with the development community for input on the recommendations.
- Establish definitions and standards for EV charging or make-ready equipment as part of a future update to the Phoenix zoning ordinance.
- Explore policies, procedures and potential code updates that would facilitate the installation of EV charging equipment or make-ready equipment in existing buildings without requiring a site plan or zoning approvals.

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- Explore minimum requirements and/or incentives for inclusion of EV ready parking spaces on new multi-family residential, commercial, office, and industrial development as part of a future update to the Phoenix zoning ordinance.
- Study the development of an incentive or development standard bonus program to encourage installation of EV charging infrastructure in new development and large expansions.

Justification: Requiring EV spaces in new construction while providing bonuses for additional spaces balances “carrot and stick” forces to ensure new buildings in Phoenix are future-ready. This will reduce burden for City staff and will speed adoption while lowering adoption costs for businesses and other end users.

**By December 2025**

Support education program to install new EV charging ports in small and large businesses and multi-family buildings.



## 2d: Single-Family Home Charging Infrastructure

### Goals:

- Implement EV-building code or EV-zoning ordinance for all new single-family developments by 2025
- Include complementary EV requirements for major renovations

Summary of Recommendations for Home Charging Infrastructure		Year
1.	Develop proposals for single-family home EV Ready building codes and zoning ordinances for stakeholder input	2022
2.	Recommend streamlining the EV charger permitting process for retrofit and major upgrades of single-family homes	2022
3.	Produce an EVSE installation guide identifying the process	2023-2024
4.	Implement code language for EV-building code/zoning ordinance	2024-2025

### Detail Recommendations

#### By December 2022

- Identify utility & City monetary & non-monetary incentives that could encourage increased EVSE adoption.
- Work with APS in consideration of its ongoing Transportation Electrification Implementation Plans (TEIPs), as well as SRP in consideration of its 2035 Sustainability Goals.
- Develop draft language for EV building code for public and developer input.
- Develop a list of stakeholders for future outreach relating to EV charging standards and proposals. Stakeholder lists may include but are not limited to design and development professionals (home builders, community members, EV charging and energy efficiency professionals, and NGOs.)
- Streamline the EV charger permitting process for retrofit and major upgrades of single-family properties within identified parameters.
  - Include opportunities/incentives for developers and builders to provide for future proofing and incentives to offset the cost of electrical conduits on new single-family developments with funding from sources outside of the planning and development permit process
  - Include input from building and development stakeholders regarding best practices for EV charging implementations.

#### By December 2023

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**City of Phoenix**

- Engage local electrical engineers to analyze the best design practices for efficient single-family installations of EVSE.

**By December 2025**

Finalize and present through public hearing process code language for EV Building code / zoning ordinance and final city council decision.



### 3. LEAD BY EXAMPLE

#### 3a: City Fleet – Purchase of Light-Duty Vehicles

**GOAL:** Purchase 200 Light Duty Electric Vehicles in the City Fleet across all departments by 2030  
(Goal is based on the City of Phoenix approved Climate Action Plan)

Summary of Recommendations for City Fleet - Light Duty		Year
1.	Develop criteria for replacing existing internal combustion engine-equipped vehicles with EVs when due or nearly due for replacement	2022
2.	Evaluate financial resources to support the transition of light-duty vehicles to EV.	2022
3.	Update procurement agreements necessary to purchase light-duty EV vehicles—leveraging cooperative contracts to purchase a wide variety of vehicles	2022

#### Detailed Recommendations

##### By December 2022

- **Develop criteria** for replacing existing internal combustion engine-equipped vehicles with EVs when due or nearly due for replacement if EVs meet the business needs considering:
  - savings that can be realized through EV fleet requiring lower maintenance and lower fuels costs than internal combustion fleets.
  - required ranges to meet operational needs, miles traveled per day, anticipated advances in technology for medium and heavy-duty models, and total cost of ownership.
  - EV fleet transition purchasing policies that prioritize EV as a first-choice option, where applicable.
  - Vehicle availability/delivery coincides with available, installed charging infrastructure.
  - funding opportunities to support capital expenses.
  - replacement cycles prioritizing replacements based on vehicle age, mileage, maintenance costs, and other relevant replacement criteria.
- Establish EV Steering Committee of City staff to oversee citywide transition to electric fleet.
- Identify funding plan to purchase light-duty EV vehicles as replacements for ICE vehicles recognizing that the up-front purchase price for EV vehicles may be higher than ICE vehicles. Pursue funding from public and private sources including federal opportunities.
- Update fleet vehicle procurement agreements regularly to ensure a wide variety of EV procurement options.
- Train vehicle operators and fleet technicians on proper EV vehicle operation and maintenance.

##### By December 2023

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- Utilize a professional consultant, as necessary, to perform an infrastructure needs assessment and assist in development of transition strategy.
- Update fleet vehicle procurement agreements regularly to ensure a wide variety of EV procurement options.
- Train vehicle operators and fleet technicians on proper EV vehicle operation and maintenance.
- Pilot fleet programs, including medium and heavy-duty vehicles.
- Decide on initial model purchases and leverage citywide contracts and cooperative agreements for vehicle purchase or leases, in alignment with available vehicle charging infrastructure.

#### By December 2025

- Evaluate potential locations of charging infrastructure compared to vehicle purchase schedule.
- Work with utilities to develop alternative charging rates and cost sharing opportunities.
- Pilot fleet programs, including medium and heavy-duty vehicles.

#### EV Fleet Planning Tools

The Electrification Coalition recently launched its Dashboard for Rapid Vehicle Electrification (DRVE) tool--an open source tool that can be used by prospective fleet managers to better estimate costs associated with light-duty, medium-duty and heavy-duty fleet electrification.

The National Association of State Energy Officials is working with state agency leads under the Volkswagen Environmental Mitigation Trust Settlement to develop a shared database of alternative fuel vehicle fleet data and associated charging infrastructure. The database, hosted by NREL's Livewire program, will allow states to upload and aggregate common economic, energy and emissions data from fleet purchases or infrastructure investments funded through the VW settlement trust. This data can then be leveraged by states as they work to support the adoption of electric vehicles and other alternative fuel vehicles.





### 3b: City Fleet – Medium & Heavy-Duty Vehicles

**GOAL:** Evaluate the performance of newly introduced electrified medium and heavy-duty vehicles for the city fleet.

Summary of Recommendations for City Fleet - Heavy Duty		Year
1.	Utilize the strategy of pilot testing for new models of medium and heavy-duty EV or other zero emission fuels, to evaluate performance	2023
2.	Develop criteria, if applicable, for replacing existing internal combustion engine equipped heavy-duty vehicles with EVs (or other zero emission fuel)	2023-2024

#### Detailed Recommendations

##### By December 2022

- **Develop criteria** for replacing existing internal combustion engine equipped vehicles with EVs when due or nearly due for replacement if EVs meet the business needs considering:
  - required ranges to meet operational needs, miles traveled per day, anticipated advances in technology for medium and heavy-duty models, and total cost of ownership.
  - local, state, and federal funding opportunities to support capital and operating expenses.
  - current replacement cycles prioritizing replacements based on vehicle age, mileage, and maintenance costs.
  - a process for keeping an up-to-date list of eligible replacement options as new models come to the market--not only listing replacement options but also timelines and availability.
  - regularly schedule meetings with fleet vendors.

#### Heavy Duty Charging Connector

Vehicle manufacturers, charging station developers, and the scientific research community are currently engaged with testing and developing a global Megawatt Charging System (MCS) standard for HD EV charging. There is a desire in the HD EV trucking sector to avoid the costs and confusion associated with the lack of a single, standard connector for LD EV charging. The Charging Interface Initiative (CharIN), a non-profit association focused on e-mobility solutions, is leading the development of this inlet hardware and connector technology in concert with the EV industry.



### 3c: Charging Infrastructure for City Fleet

**GOAL:** Install light-duty EV Charging Infrastructure at city facilities to support the charging of 200 city fleet vehicles by 2030.

Summary of Recommendations for Charging Infrastructure for City Fleet		Year
1.	Evaluate infrastructure/power needs and the required financial resources to support the transition of light-duty vehicles to EV.	2022
2.	As infrastructure is installed, develop necessary operations and maintenance procedures.	2023
3.	Install 30 or more Fleet charging ports in City facilities	2023
4.	Install 70 or more Fleet charging ports in City facilities	2024 & 2025
5.	Install 100 or more Fleet charging ports in City facilities	2025-2030

#### Detailed Recommendations

##### By December 2022

- Develop a City Operations EV Fleet Charging strategy that includes:
  - guidance for selecting EV charger types (networked or non-networked) based on data desired (tracking of mileage, maintenance schedules, department charges).
  - recommended rates of installation in advance of the purchase of EVs (just-in-time versus mass upgrades and future-proofing infrastructure through oversizing) that considers lead time needed for permits.
  - an approach for “managed charging” and guidelines for fleet use that minimizes utility costs and demand charges/peak times and leverages energy storage and microgrids including potential to use third-party owned systems to lower costs and reduce risk.
  - utility grid resiliency and charging station infrastructure—who operates, maintains, responds for emergency operations should there be malfunctions or outages. Explore how discretionary charging could be curtailed in power emergencies.
  - best practice approaches such as the Department of Energy Alternatives Fuels Data Center EVSE tool to calculate a number of L1/L2/DCFC and/or combinations needed for fleet use.
- Request to hire or train technical experts to project manage all electrical installs and electrical upgrades and permits and utility coordination.

**By December 2023**

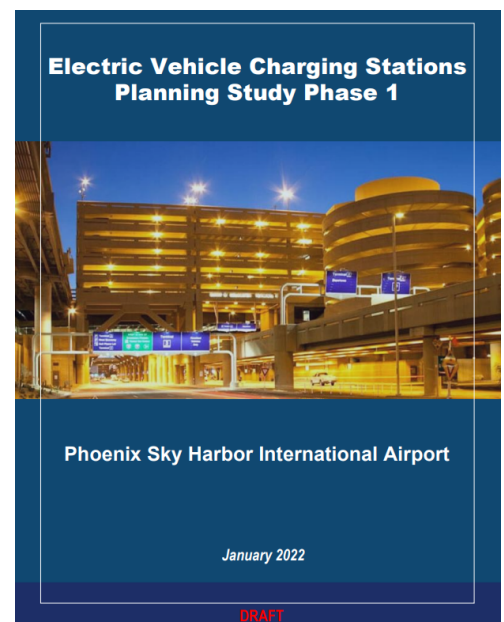
- Implement training of employees for EV driving, EV charging and EV maintenance prioritizing employee change management to achieve effective employee engagement.
- Install a minimum of 30 charging ports and associated electrical and infrastructure upgrades at City facilities with capacity for additional charging capability in the future, with maintenance contract (or many more if federal funding is available).

**By December 2025**

- Install a minimum of 70 new chargers and associated electrical and infrastructure upgrades at City facilities with capacity for additional charging capability in the future with maintenance contract (or many more if federal funding is available)

**Planning Process for EV Charging at  
Sky Harbor Airport**

Sky Harbor Airport has unique service demands including short- and long-term parking requirements for passengers and employees. Sky Harbor has an EV Charging Station Planning Study and a Capacity Demand Study underway that will inform infrastructure needs through 2030. The initial recommendations from these studies are not included alongside these recommendations except for forecasts for conversions of Aviation's light-duty vehicle fleet.



### 3d: Charging Infrastructure for Employees

**GOAL:** Build-out EV charging infrastructure for City employees to use at the workplace to meet employees' current charging needs by 2025 based on ongoing employee EV surveys.

Summary of Recommendations for Charging Infrastructure for City Fleet		Year
1.	Undertake EV Infrastructure needs assessment for employee charging	2022-2023
2.	Install 30 or more employee charging ports in City facilities	2022-2023
3.	Install 70 or more employee charging ports in City facilities	2023-2024
4.	Install 70 or more employee charging ports in City facilities	2024-2025

#### Detailed Recommendations

##### By December 2022

- Recommend Level 1 charging provided at no cost when available and Level 2 provided as initially free charging with an annual review to explore the viability of moving to cost recovery for employee EV charging and parking--exploring user fees versus City-paid as an incentive for sustainable commuting.
- Recommend locations and timing for rollout of employee/workplace charging.
- Adopt an Employee EV Etiquette Policy to maximize use of Level 2 and Level 3 charging infrastructure (i.e., vacate parking stalls when the charging session is complete).
- Provide guidance on level and type of charging infrastructure to be installed (Level 1 or 2 and DCFC, and networked vs non-networked).
- Explore incentives to encourage daytime charging and EV purchases.
- Create an employee EV survey that asks current employees who drives an EV, and who is planning to purchase in the next year, 3 years, and 5 years, and which times they are parked and in which lots (i.e., some employees may work evening hours or off-peak hours).
- Identify the number of current parking spaces per City building and the electrical service capacity at that location.
- Create a partnership with local utilities to identify EV charging rates that would apply.
- Identify guidance from the Internal Revenue Service (IRS) that allows for/ does not allow for EV employee charging as a tax-deductible benefit. If the IRS does not allow this as a tax-deductible benefit (like a subway card / metrolink / bike commuting card), then propose to City Council for EV charging to be an employee benefit.

##### By December 2023

- Identify collaborative multi-city EV charger bulk purchase opportunities across US and/or Valley to lower upfront equipment cost (i.e., driveevfleets.org, other cities, MAG).

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- Secure ongoing annual City funding to support City employees having access to EV charging by 2025 and identify opportunities that will enable ongoing expansion of EV charging through 2030 for employees.
- Purchase EV charging stations, either through any identified group-buy opportunities or through a stand-alone Request for Proposals (RFP).
- Install EV charging stations for City employees by 2025 based on results of employee EV survey.

### By December 2025

- Re-issue Employee Survey
- Identify any further collaborative multi-city EV charger bulk purchase opportunities across US and/or Valley to lower upfront equipment cost (i.e., driveevfleets.org, other cities, MAG).
- Secure ongoing annual City funding to support 100% of city employees having access to workplace EV charging by 2030.
- Purchase EV charging stations, either through any identified group-buy opportunities or through a stand-alone RFP.



# **Appendix 1**

## **Glossary of Terms**

**TYPES OF VEHICLES AND OPERATIONAL TERMS**

**(ZEV) Zero-Emission Vehicles:** ZEVs are vehicles that produce no tailpipe emissions of any criteria pollutant (or precursor pollutant) or greenhouse gas emissions from the onboard source of power, such as some plug-in hybrid electric vehicles (PHEV), battery-electric vehicles (BEV), and hydrogen fuel cell vehicles.

**(EV) Electric Vehicles:** EVs are a broad category that includes vehicles powered, at least in part, by electricity and uses a battery to store energy that powers the motor. Unless otherwise noted, EV refers to all plug-in vehicles in this report, including PHEVs and BEVs.

**(BEV) Battery-Electric Vehicles:** BEVs also known as a pure electric vehicle or an all-electric vehicle, contains batteries which can be charged externally, and store recovered braking energy. It uses an electric motor to power the vehicle. (Examples: Tesla Model 3, Chevrolet Bolt, Nissan Leaf)

**(PHEV) Plug-in Hybrid Electric Vehicles:** PHEVs are vehicles with both an internal combustion engine and electric motor that can be powered either by gas or electricity through a rechargeable battery. PHEVs may be zero-emission vehicles if they're operated entirely as EVs but are not true ZEVs because the hybrid mode includes use of an internal combustion engine. (Examples: Chevrolet Volt, Chrysler Pacifica, Mitsubishi Outlander)

**(FCEV) Fuel Cell Electric Vehicles:** Vehicles that produce electricity using hydrogen gas and produce no harmful tailpipe emissions, just water vapor.

**(ICEV) Internal Combustion Engine Vehicles:** ICE vehicles have an engine that is powered by a fossil fuel (gas or diesel) in which the combustion of a fuel occurs with an oxidizer in a combustion chamber. This type of vehicle is associated with tailpipe emissions.

**Regenerative Braking:** A method of braking used by an EV in which the energy that would have been lost as heat energy during braking is captured using a traction motor and stored in the battery.

**Battery Management System:** An electronic system within an EV that manages battery parameters such as state of charge, state of battery, maximum and minimum limits of energy. It also protects the battery by controlling energy flow to and from the battery.

**Lithium-Ion Battery:** Commonly used battery material used to power an EV.

**ELECTRIC VEHICLE CHARGING TERMS**

**(EVSE) Electric Vehicle Supply Equipment:** Refers to all of the equipment associated with transferring electric energy to a battery or other energy storage device in an electric vehicle. This includes hardware, including connectors, fixtures, devices, and other components. This is commonly called a charging station.

**Level 1:** AC Level 1 EV charging (often referred to simply as Level 1) provides charging through a 120-volt (120V) single-phase AC plug (a typical wall outlet) at 12-16 amps. Level 1 EV chargers



provide about 3-5 miles of range per hour of charging. This type of charging is usually done at home.

**Level 2:** AC Level 2 EV charging offers charging through 240V (typical in residential applications) or 208V (typical in commercial applications) single-phase electrical service (like a dryer plug) at 12-80 amps (typically 32 amps). Level 2 EV chargers provide about 10-20 miles of range per hour of charging.

**(DCFC) Direct-current fast charging:** DCFC equipment (typically 208/480V AC three-phase input and less than 125 amps), enables rapid charging at a rate of at least 25 kW, with newer chargers rated up to 350 kW. Most commonly, DCFC can provide about 125 miles in 20-30 minutes.

**Fleet Charging:** EV charging infrastructure to accommodate a light-, medium- or heavy-duty fleet. Fleet charging infrastructure may consist of Level 2 and DC Fast Chargers based on fleet operator's needs.

**Employee/Workplace Charging:** EV charging infrastructure provided by an employer for employee use while at work.

**Public Charging:** Public EV charging covers a wide range of situations where an EV driver could potentially charge when away from home or work. Examples: libraries, parks, shopping centers, museums.

**Bidirectional Charging:** An EV charger that can flow charge to a battery and from battery to grid, vehicle and home.

**State of Charge:** State of charge is the level of charge of an electric battery relative to its capacity. The units of State of charge are percentage points (0% = empty; 100% = full).

**Range:** The total distance an EV can travel on one full charge before the battery needs to be recharged.

**Range Anxiety:** Range anxiety is the fear that an EV has insufficient range to reach its destination and would thus strand the vehicle's occupants. Studies show that driving range is one of the primary barriers to EV adoption.

### **EV EQUITY TERMS**

**EV Equity:** EV equity is increasing access to and use of EVs among low- and moderate-income individuals to reduce impacts of climate change attributed to greenhouse gas emissions and health impacts attributed to air quality emissions.

### **MOBILITY TERMS**

**Bike Share:** Bike share is a service where bicycles are available for shared use to individuals on a short-term basis.

**Car Share:** Car share is a service that gives members access to an automobile for short-term use — usually by the minute, hour, or day.

**E-Bike:** E-bikes are bicycles with an electric motor that can be used for propulsion. There are a few different types of e-bikes:

**Class 1:** The electric drive on the e-bike is only activated by pedaling and ceases to provide assistance once the e-bike reaches 20 mph. Unless otherwise specified, the term e-bike refers to Class 1 pedal-assist e-bikes.

**Class 2:** The electric drive on the e-bike can be activated through a throttle element and may also be activated through pedaling with top speeds limited to 20 mph.

**Class 3:** The electric drive system on the e-bike is activated by pedaling and ceases to provide assistance once the e-bike reaches 28 mph.

**Class 4: Motorcycle/Moped:** The electric drive system is activated by pedaling or throttle. These e-bikes can reach top speeds above 28 mph.

**Micromobility:** Use of a low-speed travel mode or use by a single person and includes use of e-scooters and bikes to travel distances five miles or less and often to or from another mode of transportation (bus, train, car).

**Multimodal:** Characterized by several different travel modes or options.

**On Road:** On-Road vehicles means any motor vehicle intended for use on the road, being complete or incomplete, having at least four wheels and a maximum design speed exceeding 15 mph.

**Off Road:** Off-Road Vehicle means any vehicle while it is being operated on a road not maintained by a federal, provincial, state, or local agency, not including entrance or departure ways to private property, or any vehicle which cannot be licensed to drive on a public road and is designed and manufactured primarily for off-road usage.

**Shared Mobility:** Shared use of a travel mode.

**(TNCs) Transportation Network Companies:** Programs, like ride-hailing apps, that provide prearranged and on-demand transportation services for compensation by connecting drivers of personal vehicles with passengers through mobile applications.

**Transit Vehicles:** Vehicles which carry passengers or public riders. It does not include school buses or charter buses.

#### **FLEET-RELATED TERMS**

**LDV: Light-Duty Vehicles:** Any Class One or Two motor vehicle designed primarily for transportation of persons and having a design capacity of twelve persons or less with a Gross Vehicle Weight Rating of 8,500 or less. This includes sedans, full size pick-ups and minivans.

**MDV: Medium-Duty Vehicles:** Any Class Two to Six motor vehicle having a Gross Vehicle Weight Rating between 8,500 and 26,000 pounds.

**HDV: Heavy-Duty Vehicles:** Any class Seven and above motor vehicle having a Gross Vehicle Weight Rating over 26,000 pounds.

**SUV:** Sport Utility Vehicle

**ELECTRICITY AND ENERGY RELATED TERMS**

**Ampere (Amp):** A unit used to measure electric current (how fast an electric current flows), usually used in the context of EV charging (i.e., a 50-amp EV charger).

**Kilowatt (kW):** The basic measurement of an EV's power that is generated by its batteries. Kilowatts = 1,000 watts)

**Kilowatt/hour (kWh):** The kilowatt-hour (kWh) is a unit of energy and is commonly used as a billing unit for energy delivered to consumers by electric utilities. A kWh is a measure of how much energy you're using. It doesn't mean the number of kilowatts you're using per hour. It is simply a unit of measurement that equals the amount of energy you would use if you kept a 1,000-watt appliance running for an hour. If you switched on a 100-watt light bulb, it would take 10 hours to rack up 1 kWh of energy. While a 50-watt item could stay on for 20 hours before it used 1 kWh.

**Volt:** A measure of the electromotive force that drives electrons through a circuit (pressure).

**Demand Charges:** There are two parts to a commercial electricity bill: Energy charges are based on the total amount of electricity you use, while demand charges are based on your highest "peak usage". These demand charges are determined by the highest 15-minute average usage recorded on your demand meter that month. Demand charges are applied to help pay-down the costs of maintaining the utility's delivery system (the power lines) and preserve power availability for all customers across the grid. Additionally, demand charges are intended to incentivize customers to both reduce their peak energy usage and shift their energy usage to non-peak times of day.

**Managed Charging:** Relies on communication signals from a utility to be sent to a vehicle or charging device to control charging events. Managed charging programs fall into two categories: passive and active. Passive programs focus on altering customer charging behaviors. One way to achieve this is using time-varying rates to incentivize customers to charge during less expensive off-peak hours. Active managed charging programs provide utility companies with the capability to determine and/or control charging time, scale, and location to manage peaks or absorbing excess renewable generation.

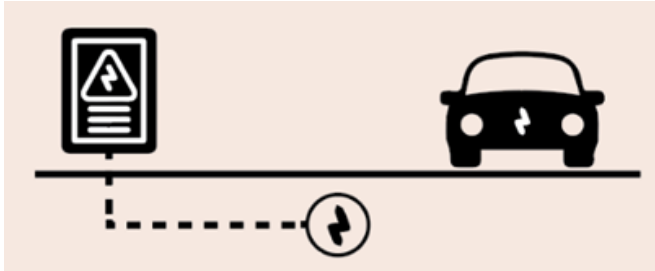
**Off-Peak Charging:** Charging your EV at certain lowest cost off-peak hours, usually during nighttime hours.

**Renewable Energy:** Energy sources that naturally replenish, such as solar or wind power.

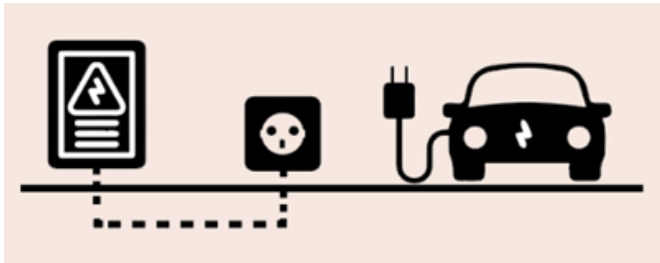
**EV BUILDING CODE-RELATED TERMS**

**EV Infrastructure Building Codes:** Require parking in new buildings to include the electrical equipment necessary to enable installation of electric vehicle (EV) charging stations. EV building codes give more people the option to drive an EV by increasing the number of charging stations and by bringing down charger installation costs by 75% or more compared to installing EV chargers during a building retrofit.

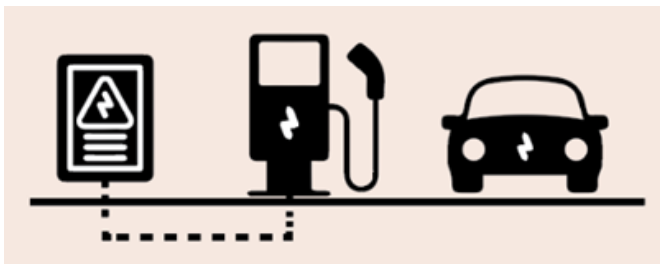
**EV-Capable:** Install electrical panel capacity with a dedicated branch circuit and a continuous raceway from the electrical panel to the future EV parking spot.



**EVSE-Ready Outlet:** Install electrical panel capacity and raceway with conduit to terminate in a junction box or 240-volt charging outlet.



**EVSE-Installed:** Install a minimum number of Level 2 EV charging stations.



**CLIMATE-RELATED ACRONYMS:**

**CAP:** Climate Action Plan

**GHG:** Greenhouse Gas such as Carbon Dioxide that contributes to global warming through the absorption of infrared radiation.